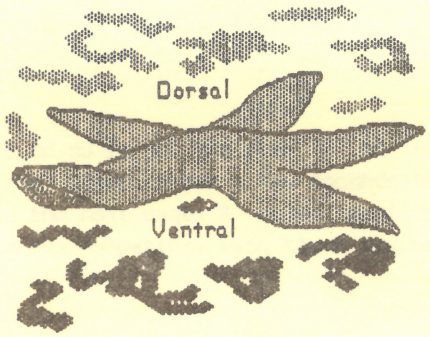
APPLE

COMPUTER BIOLOGY LAB

STARFISH

by Larry Newby



CROSS EDUCATIONAL SOFTWARE

STARFISH DISSECTION

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Larry Newby

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INTRODUCTION

"STARFISH DISSECTION" can be used as a pre-lab or post-lab computer activity. It gives instructions and definitions that a student should know before entering the lab. After a dissection the program can be used as a self-test. The reading level and content are meant for seventh and tenth grade biology students.

GETTING STARTED

All you have to do is put the disk in an Apple computer and turn on the power. After a few seconds the screen will show the menu on the next page. A color monitor will help, but the pictures are compatible with black and white.

COPIES

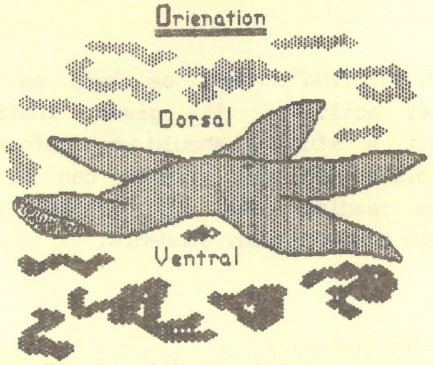
This disk is protected against being copied. A backup disk is included in case of accident. If the disk doesn't run when you receive it, it will be replaced free. Just mail it back to Cross Educational Software. If the disk fails after being used for 30 days, it could be due to mishandling, such as a scratch or a fingerprint. After 30 days there is a $6 charge to replace a disk.

MANUAL AND TESTS

The following pages are a summary of the program. The test pages can be duplicated and given to students if there isn't enough time for all students to run the program during class.

MAIN MENU

1) ORIENTATION
2) STRUCTURES AND FUNCTIONS
3) SELF TEST
4) STUDENT CONTROLLED DISSECTION



1) ORIENTATION: VOCABULARY LIST

AMPULLA	EXOSKELETON	RECTAL SAC
ANUS	GONAD	RING CANAL
COELOM	INTESTINE	SIEVE PLATE
DERMAL GILL	LATERAL CANAL	SPINE
DIGESTIVE GLAND	MADREPORITE	STOMACH
DORSAL	PEDICELLARIA	STONE CANAL
DUCT	RADIAL CANAL	TUBE FEET
ECHINODERM	RAY	VENTRAL

GENERAL BACKGROUND

The starfish is an improperly named animal. It does not belong to the fish group but to a separate group called echinoderms. Echinoderm means "spiny skin." This spiny skin helps to make up the tough exoskeleton or outer covering which gives the starfish form and helps protect it. The starfish is radially symmetrical meaning that all body parts are developed uniformly around a central body point. It does not have a definite anterior or posterior but it does have a dorsal and ventral surface.

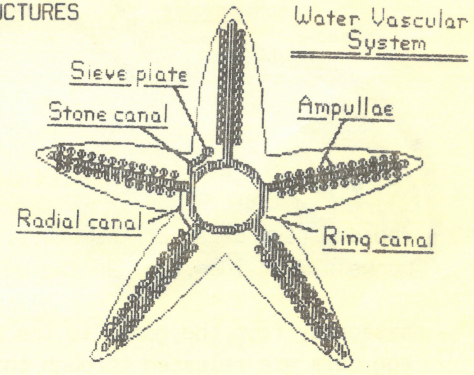
The starfish has no circulatory system to speak of. The salty water is moved through the dermal gills and into the hollow body cavity (coelom) inside of the exoskeleton. Here the internal gills are bathed in "fresh" water, getting the needed oxygen.

The starfish has fantastic powers of regeneration. This means that it is able to regrow missing parts. If it loses a leg or two to a predator it will simply regrow these missing legs in a short time. For this reason the starfish is particularly interesting to man.

This animal also has economic importance to man. Because it feeds on oysters, man considers it a competitor. For many years starfish have been captured and killed by various methods. Before man learned about the starfish's powers of regeneration, he would cut the starfish into pieces whenever he captured then and dump these pieces back into the sea. The fishermen were amazed to find that their problems were not solved but only compounded!

2) DEFINITIONS OF STRUCTURES

A) VASCULAR SYSTEM



SIEVE PLATE - dark structure on the dorsal surface.
Entrance to the vascular system.
Serves as a filter. Also called madreporite.

STONE CANAL - short canal that connects sieve plate to ring canal.

RING CANAL - circular canal that carries water to each radial canal

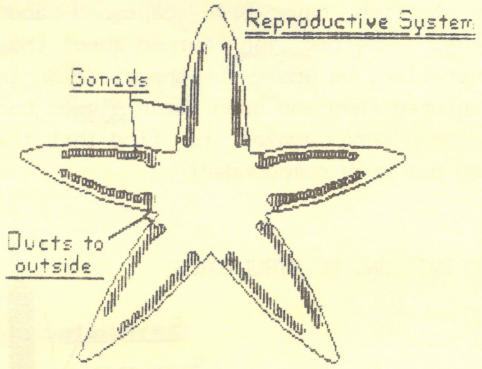
RADIAL CANAL - carries water to all of lateral canals

AMPULLA - (plural ampullae) bulb-like structures that control the tube feet

LATERAL CANAL - connects radial canal to the ampullae

TUBE FEET - structure controlled by the ampullae; aids in feeding and movement

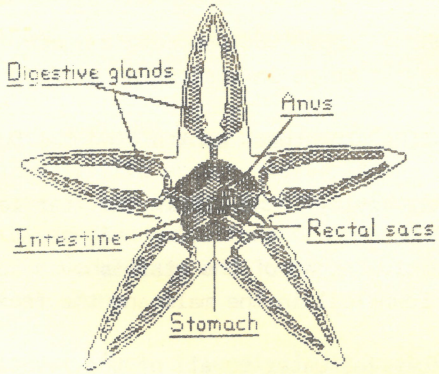
B) REPRODUCTIVE SYSTEM



GONAD - reproductive organ of the starfish.
Looks almost identical in the male and the female.

DUCT - passageway from the gonad to the outside. Sperm and egg cels are released through this duct.

C) DIGESTIVE SYSTEM



MOUTH - Opening found on the ventral side. Takes in food.

STOMACH - expelled through mouth and covers food with digestive juices. Retracted into body after meal is finished.

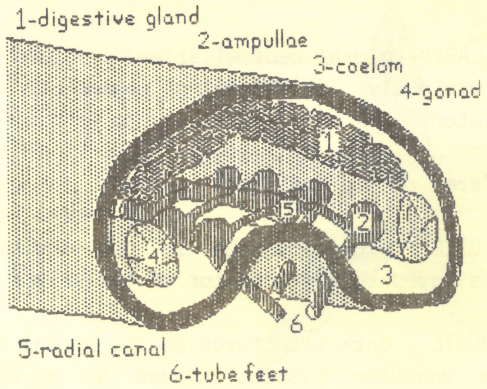
RECTAL SAC - sac-like structures found near the intestine. Exact function not known. Seem to store wastes.

INTESTINE - area near stomach. Little digestion takes place here. Moves wastes toward anus.

DIGESTIVE GLAND - organ that secretes digestive enzymes and helps in absorption of food particles.

ANUS - opening on dorsal surface used for the elimination of waste.

D) CROSS SECTION



DIGESTIVE GLAND - organ that secretes digestive enzymes and helps in absorption of food particles.

AMPULLA - bulb-like structures controlling the tube feet.

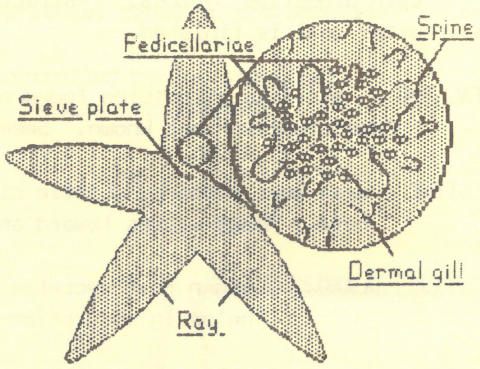
COELOM - internal cavity found within the starfish.

GONAD - reproductive organ of the starfish.
Almost identical in the male and the female.

RADIAL CANAL - carries water to all of the lateral canals.

TUBE FEET - structure controlled by the ampulla.
Aids in feeding and movement.

E) EXTERNAL FEATURES



SPINE - hard pointy structure that aids in protection.
Found on dorsal and ventral surfaces.

PEDICELLARIA (plural pedicellariae) - tiny structures that snap viciously at anything coming in contact with the exoskeleton.

RAY - "arm" of the starfish.

DERMAL GILL - tiny openings in the skeleton, where fresh water is moved to the interior of the starfish.

SIEVE PLATE - dark structures on the dorsal surface. Entrance to the vascular system. Serves as a filter. Also called madreporite.

GUIDELINES FOR A STARFISH DISSECTION

The following dissection may be used in conjunction with any type of biology or life science text. It may also be used as a pre-dissection activity to acquaint the student with the general starfish dissection guidelines or as a post-dissection activity to reinforce vocabulary and concepts covered in an actual starfish dissection.

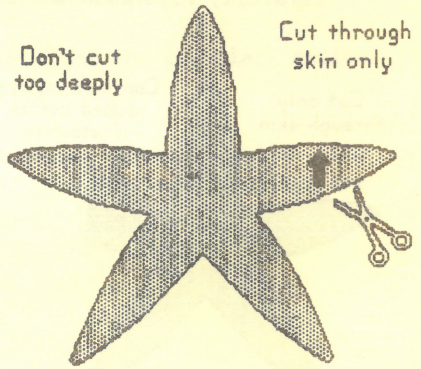
This program is very 'user friendly.' It uses few keys including:

<==	LEFT ARROW KEY	(Back up a page.)
==>	RIGHT ARROW KEY	(Go ahead.)
'RTN'	RETURN KEY	(Switch between text and graphics.)
'ESC'	ESCAPE	(Get out.)

GENERAL DISSECTION GUIDELINES

We shall begin this dissection by placing the specimen dorsal surface up in the dissecting tray. The dorsal surface can be identified by finding the circular disk or sieve plate near the center of the starfish. The ventral surface can be easily recognized by the channels which radiate out from the center. Within each channel you can see many tube feet.

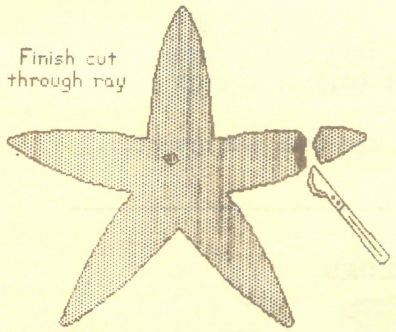
Using your scissors, make an incision around one of the rays about an inch or so away from the end. Cut only through the hard outer skin or exoskeleton. The incision should end at the same point at which it started. (See picture.)

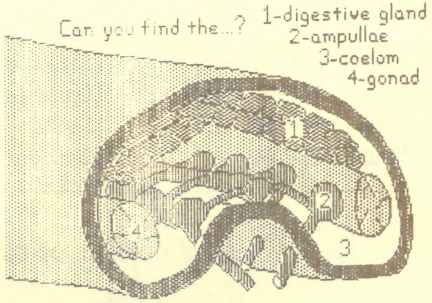


Using your scalpel, finish cutting off the ray. The scalpel is being used because it makes a clean cut and exposes a usable cross-section. Once the cross-section is visible, proceed to the next step.

Observing the cross-section of your specimen, identify the major structures within the ray.

Once you have located and identified these structures, you may go on and find out how they are positioned within the body of the starfish.



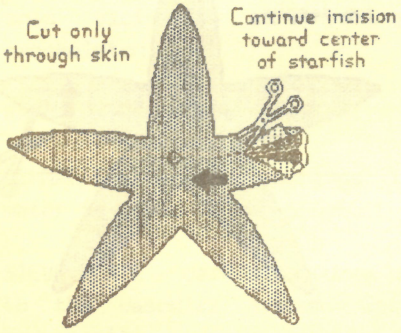


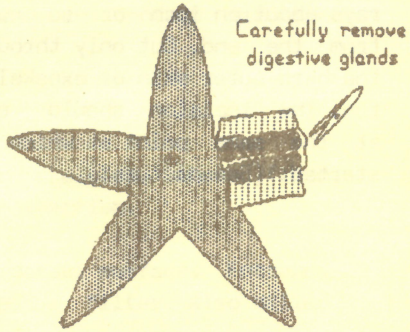
Using your scissors, make an incision along the dorsal surface of the ray you have just exposed.

Stop the incision at a point where the ray seems to join the main body.

Be careful to cut through only the skin and not disturb the underlying structures.

Carefully fold back the skin as you cut. (See picture.)





Observe the digestive glands and how they are situated within the ray.

Using your forceps, carefully lift and remove the digestive glands from the ray of the starfish.

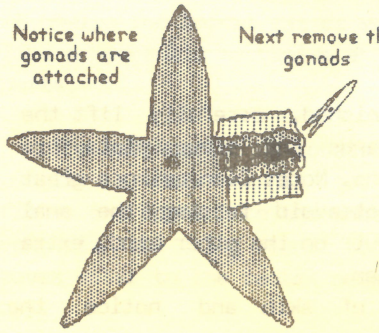
Be careful to remove only the digestive glands!

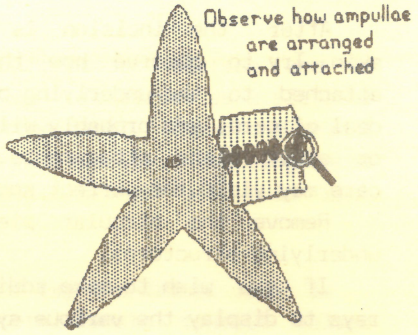
Once the digestive glands have been removed, you should see the exposed gonads or reproductive organs.

The male and female reproductive organs look almost identical to the naked eye.

The size of the organs may vary depending on when the starfish was collected. During the mating season the gonads may extend out to almost the end of the ray. During other times they may extend only a short distance into the ray.

Again using your forceps carefully remove the gonads.





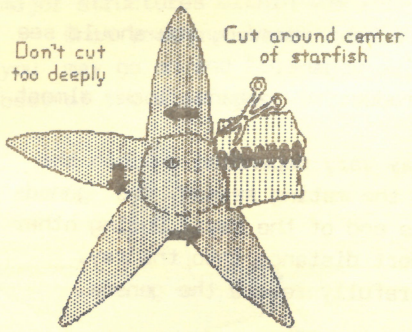
You should now be able to observe how the vascular system is situated in the ray of the starfish.

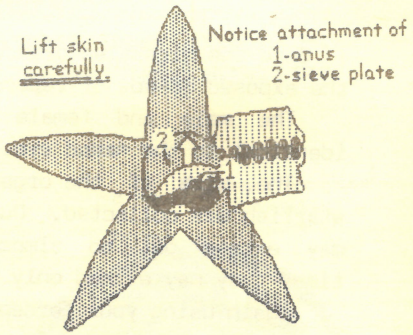
Using a magnifying glass or hand lens, examine the ampullae. Notice how the ampullae are arranged within the ray. Can you see any type of pattern?

Using your scissors, make a circular incision around the main body (dorsal surface) of the starfish. (See picture.)

Be extremely careful to cut through only the skin!

Try not to disturb any of the underlying structures.



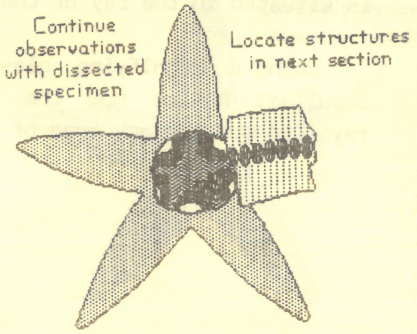


After the incision is finished, carefully lift the skin. Try to observe how the anus and sieve plate are attached to the underlying organs. Note: Even using a great deal of care, you probably will not avoid tearing the anal or sieve plate attachments. But on the other hand, extra care may yield the perfect specimen.

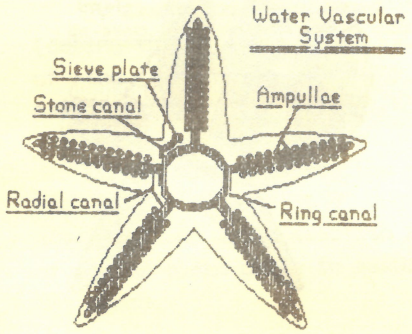
Remove the circular piece of skin and notice the underlying structures.

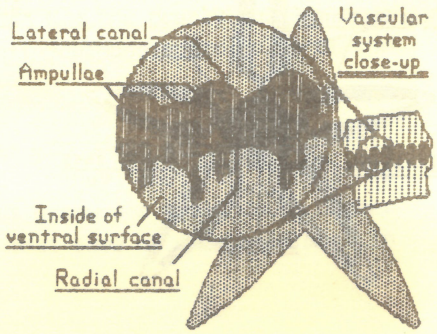
If you wish to make additional incisions in any of the rays to display the various systems, do so using the same type of incision that you used to open the first ray.

Using your specimen, proceed to the next part of this program where the individual systems will be discussed.



VASCULAR SYSTEM





The vascular system in the starfish serves two functions. It helps the animal eat as well as move. It works very much like a hydraulic mechanism and is made up of several distinct parts.

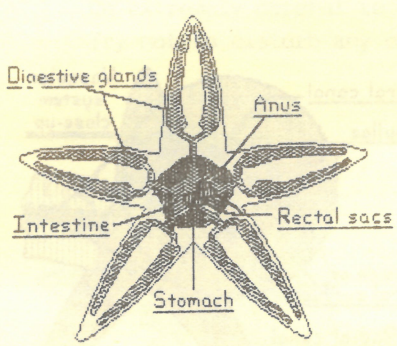
The madreporite is located on the dorsal surface and is usually a dark orange or yellow. It serves as a sieve or filter and opens into the short stone canal. The stone canal connects the ring canal to the madreporite. The ring canal moves water to the radial canals which branch out into each ray.

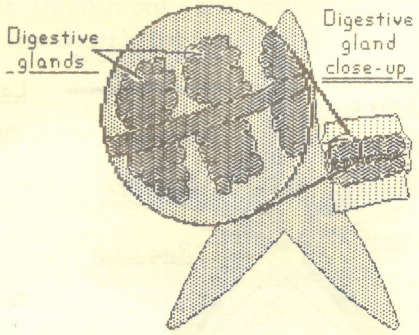
Along the entire length of the ray, the radial canal is joined by lateral canals. The lateral canals contain valves which regulate the amount of water in the ampulla.

The bulb-like ampulla is able to contract which causes the water to rush into the tube foot. This causes the tube foot to extend. A suction cup-like structure is at the end of each tube foot and is controlled by the water moving into and out of the foot.

By pumping water in and out of the foot, the starfish is able to move across the bottom of the ocean. By attaching itself to an oyster or clam with its tube feet and exerting a constant pull, the starfish is able to weaken the prey, open the shell, and enjoy a meal.

DIGESTIVE SYSTEM

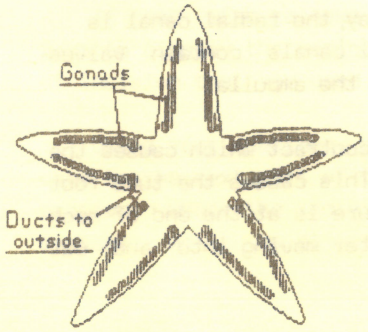


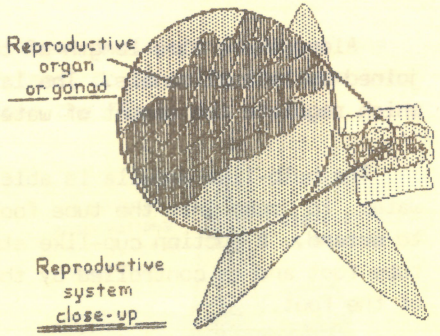


The process of feeding is very unusual in the starfish. When the starfish finds or captures a meal, it pushes its stomach out of its mouth and spreads it over the food. The stomach secretes a very powerful digestive enzyme which digests the food. This digested material is then swallowed and enters the intestine. Here the nutrients are absorbed by the intestine and the digestive glands which are attached to it. The unused material is eliminated through the anus.

Attached to the intestine are several small sac-like structures called rectal sacs. Their function is not known.

REPRODUCTIVE SYSTEM

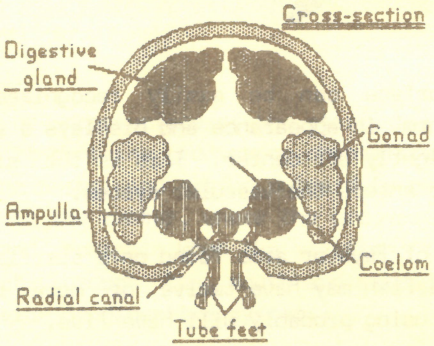




The reproductive systems of the male and female starfish are almost identical to the naked eye. In fact, one can distinguish between the two only by examining them under the microscope.

By examining the gonads of a newly collected starfish (during the mating season) you can see the pearly looking eggs of the female or the tiny tail-equipped sperm cells of the male.

During mating season the eggs and sperm are released into the water through the ducts. They meet to form a new starfish. An adult starfish must produce a tremendous number of egg or sperm cells to assure that some of them will meet in the ocean.



CROSS-SECTION

Viewing the cross section of a starfish ray, we are able to see most of the important structures.

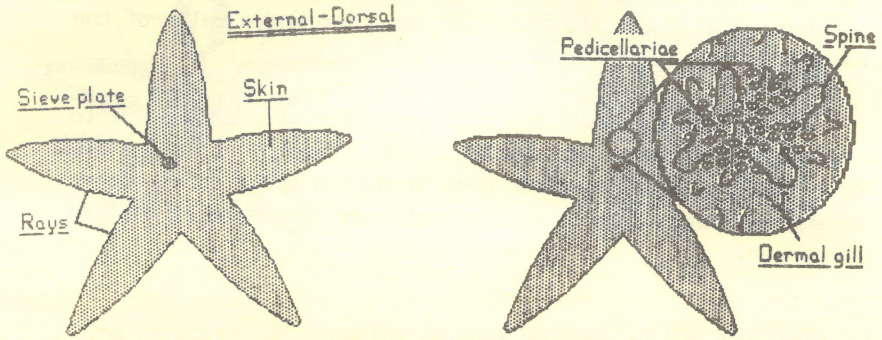
The digestive glands are located on the inside of the dorsal surface. They are responsible for nutrient absorption.

The ampulla (plural-ampullae), radial canal, and tube feet are all part of the vascular system.

The gonad is the reproductive organ of the starfish.

The coelom is a cavity within the starfish's ray where water is allowed to circulate and bring oxygen to the cells.

EXTERNAL FEATURES - DORSAL VIEW



The dorsal surface can be easily recognized. It is relatively uniform in appearance and displays a small orange or yellow dot slightly off center. This is the sieve plate. It is where water enters the vascular system.

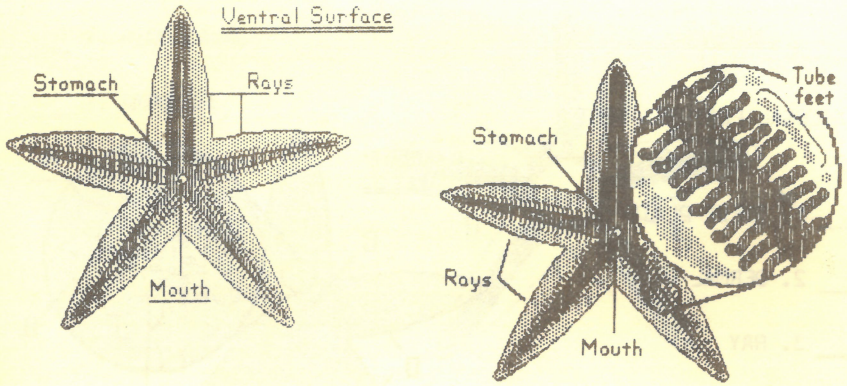
The number of rays or arms found on a starfish may vary. Some types of starfish may have twelve or more rays. The specimen you are using probably will have five.

The skin or exoskeleton of the starfish is very rough and hard. It is a protective shield which protects the softer more delicate parts underneath. Upon closer inspection you will find that the skin is actually made up of different types of structures. (See close-up.)

The larger of these bumps are the spines. They offer a form of protection from any would-be enemy.

The dermal gills are part of the skin that actually help the starfish breathe by taking oxygen from the water. The pedicellariae (singular-pedicellaria) are very small structures found on the skin. They are pincer-like and snap viciously at anything that stimulates them. They may remain closed for several days after they shut. For this reason starfish are able to be captured by "sea mops."

EXTERNAL FEATURES - VENTRAL VIEW



The ventral or undersurface of the starfish is very easy to recognize. It contains grooves or channels which begin in the center of the animal and extend outward to nearly the end of each ray. In the center, where the grooves meet, you can find the mouth and stomach. When the starfish feeds it drops its stomach out through the mouth and extends it over the food. (See section on digestive system.)

Along nearly the entire length of the channel you can find the tube feet. The tube feet are structures that enable the starfish to move and capture its food. Each tube foot is equipped with a suction cup at its tip. This suction cup is controlled by the vascular system. By attaching and releasing in a coordinated manner, the starfish is able to move along horizontal as well as vertical surfaces.

The tube feet are also able to grasp and hold the shells of oysters and clams. By using a constant pulling action the starfish is able to weaken the prey so that its shell starts to open. The starfish then drops its stomach between the shells and digests its prey.

EXTERNAL FEATURES TEST

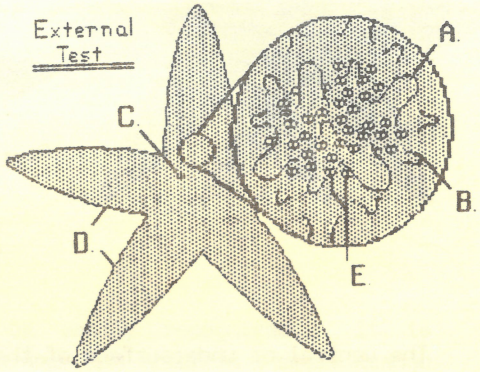
___ 1. SIEVE PLATE

___ 2. DERMAL GILL

___ 3. RAY

___ 4. SPINE

___ 5. PEDICELLARIAE



DIGESTIVE SYSTEM TEST

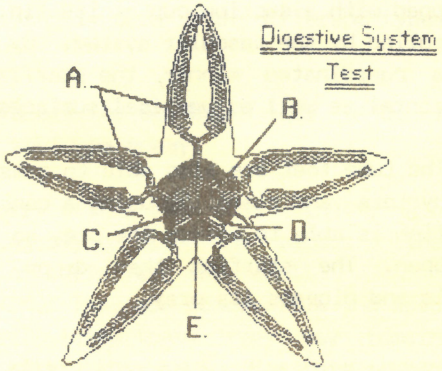
___ 1. STOMACH

___ 2. ANUS

___ 3. DIGESTIVE GLAND

___ 4. INTESTINE

___ 5. RECTAL SACS



VASCULAR SYSTEM TEST

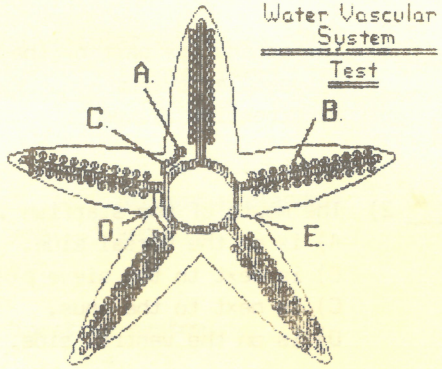
___ 1. RING CANAL

___ 2. AMPULLAE

___ 3. STONE CANAL

___ 4. SIEVE PLATE

___ 5. RADIAL CANAL



CROSS SECTION TEST

___ 1. RADIAL CANAL

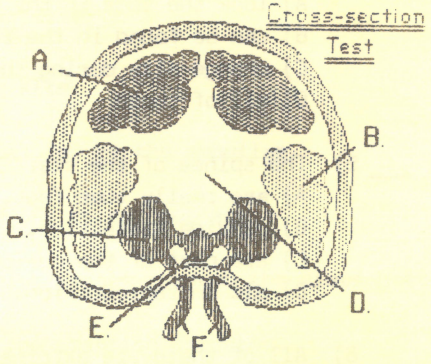
___ 2. DIGESTIVE GLAND

___ 3. GONAD

___ 4. COELOM

___ 5. TUBE FEET

___ 6. AMPULLA



MULTIPLE CHOICE TEST

___ 1) The gonads are part of the ...
A) vascular system
B) digestive system
C) exoskeleton
D) reproductive system

___ 2) The mouth of the starfish ...
A) is on the dorsal side.
B) is next to the sieve plate.
C) is next to the anus.
D) is on the ventral side.

___ 3) The egg and sperm cells are ...
A) released through ducts.
B) joined inside of the female.
C) joined inside of the male.
D) easily seen with naked eye.

___ 4) The gonads of the starfish ...
A) look the same in the male and female starfish.
B) can be found in the ray.
C) change size during the breeding season.
D) all of these

___ 5) The spines of the starfish ...
A) are really tube feet.
B) provide protection.
C) are part of the coelom.
D) aid in reproduction.

___ 6) All of these are external features except ...
A) the dermal gills
B) spines
C) coelom
D) pedicellariae

___ 7) The digestive glands ...
A) secrete enzymes and absorb nutrients.
B) help the ray to move.
C) regulate water movement.
D) control the ampullae.

___ 8) All are parts of the vascular system except ...
A) radial canal
B) ampullae
C) lateral canal
D) pedicellariae

___ 9) Which of the following can not be found in the starfish ray?
A) circular canal
B) reproductive organs
C) digestive glands
D) ampullae

___ 10) The sieve plate ...
A) is part of the digestive system.
B) is in the dorsal surface.
C) is attached to the ampulla.
D) is found in the male only.

TRUE / FALSE TEST # 1

___ 1. The starfish digests food outside of its body.

___ 2. The pedicellariae attack anything that touches the outside of the starfish.

___ 3. The gonads can vary in size.

___ 4. The tube feet are controlled by the ampullae.

___ 5. The anus is located on the dorsal surface.

___ 6. Water enters the vascular system through the sieve plate.

___ 7. The dermal gills help the starfish 'breathe.'

___ 8. The starfish has an internal skeleton.

___ 9. The stone canal is attached to the sieve plate.

___10. The tube feet help the starfish to digest food.

TRUE / FALSE TEST # 2

___ 1. The starfish's mouth is used for chewing.

___ 2. The pedicellariae help the starfish to move.

___ 3. The gonads look almost the same in the male and female starfish.

___ 4. The tube feet are equipped with suction cups.

___ 5. The anus is located on the ventral surface.

___ 6. Water enters the vascular system through the tube feet.

___ 7. The dermal gills are found on the inside of the starfish.

___ 8. The starfish has an external skeleton.

___ 9. The stone canal is attached to the radial canal.

___10. The tube feet help the starfish to move.

TRUE / FALSE TEST # 3

___ 1. The starfish is able to extend its stomach outside of its body.

___ 2. The pedicellariae are found on the exterior of the starfish.

___ 3. The gonads are part of the reproductive system.

___ 4. The tube feet help the starfish to eat.

___ 5. The anus is used for waste removal.

___ 6. Water enters the vascular system through the ampullae.

___ 7. The dermal gills are found on the exterior of the starfish.

___ 8. The starfish has no skeleton.

___ 9. The stone canal is attached to the circular canal.

___10. The tube feet help the starfish to reproduce.